BEST AVAILABLE COPY

The Patent Office

PATENTS • DESIGNS • COPYRIGHT • TRADE MARKS

PCT/GB 2004 / 0 0 2 3 8 6 05

INVESTOR IN PEOPLE

The Patent Office
Concept House
Cardiff Road
Newport
South Wales
NP10 8QQ

REC'D 01 JUL 2004
WIPO PCT

I, the undersigned, being an officer duly authorised in accordance with Section 74(1) and (4) of the Deregulation & Contracting Out Act 1994, to sign and issue certificates on behalf of the Comptroller-General, hereby certify that annexed hereto is a true copy of the documents as originally filed in connection with the patent application identified therein.

I also certify that the attached copy of the request for grant of a Patent (Form 1/77) bears an amendment, effected by this office, following a request by the applicant and agreed to by the Comptroller-General.

In accordance with the Patents (Companies Re-registration) Rules 1982, if a company named in this certificate and any accompanying documents has re-registered under the Companies Act 1980 with the same name as that with which it was registered immediately before re-registration save for the substitution as, or inclusion as, the last part of the name of the words "public limited company" or their equivalents in Welsh, references to the name of the company in this certificate and any accompanying documents shall be treated as references to the name with which it is so re-registered.

In accordance with the rules, the words "public limited company" may be replaced by p.l.c., plc, P.L.C. or PLC.

Re-registration under the Companies Act does not constitute a new legal entity but merely subjects the company to certain additional company law rules.

PRIORITY DOCUMENT
SUBMITTED OR TRANSMITTED IN COMPLIANCE WITH RULE 17.1(a) OR (b)

Signed: Stephen Hordley

Dated 23 June 2004

Patents Form 1/77

Paten[illegible] t 1977
[illegible]ule

THE PATENT OFFICE
K
NEWPORT

The Patent Office

06JUN03 E813044-1 B12285
P01/7700 0.00-0313044.0

THE PATENT OFFICE
K
- 6 JUN 2003
NEWPORT

Request for grant of a patent

(See the notes on the back of this form. You can also get an explanatory leaflet from the Patent Office to help you fill in this form)

The Patent Office

Cardiff Road
Newport
South Wales
NP10 8QQ

1. Your reference

2. Patent application number *(The Patent Office will fill in this part)* — 0313044.0

3. Full name, address and postcode of the or of each applicant *(underline all surnames)*

Cambridge Flat Projection Displays Ltd, Manor House, 46 Chequer Street, Fenstanton, Cambridgeshire, PE28 9JQ

Patents ADP number *(if you know it)*

If the applicant is a corporate body, give the country/state of its incorporation — 8647026001

4. Title of the invention

Flat Panel Scanning Illuminator

5. Name of your agent *(if you have one)*

"Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*

Haseltine Lake
Imperial House
15-19 Kingsway
LONDON
WC2B 6UD

F51/77
4/6/04
ES

~~Dr A. Travis, Clare College, Cambridge, CB3 9AJ~~

Patents ADP number *(if you know it)* ~~763175001~~

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and *(if you know it)* the or each application number

Country	Priority application number *(if you know it)*	Date of filing *(day / month / year)*

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application	Date of filing *(day / month / year)*

8. Is a statement of inventorship and of right to grant of a patent required in support of this request? *(Answer 'Yes' if:*
   a) any applicant named in part 3 is not an inventor, or
   b) there is an inventor who is not named as an applicant, or
   c) any named applicant is a corporate body.
   See note (d))

Yes

Patents Form 1/77

9. Enter the number of sheets for any of the following items you are filing with this form. Do not count copies of the same document

Continuation sheets of this form

Description 3

Claim(s)

Abstract

Drawing(s) 3 + 3 [illegible]

10. If you are also filing any of the following, state how many against each item.

Priority documents

Translations of priority documents

Statement of inventorship and right to grant of a patent *(Patents Form 7/77)*

Request for preliminary examination and search *(Patents Form 9/77)*

Request for substantive examination *(Patents Form 10/77)*

Any other documents *(please specify)*

11. I/We request the grant of a patent on the basis of this application.

Signature A-Travis Date 4 June 2005

12. Name and daytime telephone number of person to contact in the United Kingdom ADRIAN TRAVIS 01223 332735

Warning

After an application for a patent has been filed, the Comptroller of the Patent Office will consider whether publication or communication of the invention should be prohibited or restricted under Section 22 of the Patents Act 1977. You will be informed if it is necessary to prohibit or restrict your invention in this way. Furthermore, if you live in the United Kingdom, Section 23 of the Patents Act 1977 stops you from applying for a patent abroad without first getting written permission from the Patent Office unless an application has been filed at least 6 weeks beforehand in the United Kingdom for a patent for the same invention and either no direction prohibiting publication or communication has been given, or any such direction has been revoked.

Notes

a) *If you need help to fill in this form or you have any questions, please contact the Patent Office on 08459 500505.*

b) *Write your answers in capital letters using black ink or you may type them.*

c) *If there is not enough space for all the relevant details on any part of this form, please continue on a separate sheet of paper and write "see continuation sheet" in the relevant part(s). Any continuation sheet should be attached to this form.*

d) *If you have answered 'Yes' Patents Form 7/77 will need to be filed.*

e) *Once you have filled in the form you must remember to sign and date it.*

f) *For details of the fee and ways to pay please contact the Patent Office.*

Flat Panel Scanning Illuminator

This invention describes a way of making a liquid crystal display which can show moving images without smear.

Liquid crystal displays are more compact than cathode ray tubes so are replacing them for television and for use in computer displays. But televisions are often used to show sport, and the images of moving objects such as balls and people get smeared on liquid crystal displays. This is not because liquid crystal switches slowly, but is because the emission from a liquid crystal pixel is sustained, whereas that from a cathode ray tube is pulsed.

A liquid crystal display conventionally comprises a liquid crystal panel and a back-light. A picture is formed on the panel by spatial modulation of the transparency of the liquid crystal, and the picture is made visible to the viewer by the back-light. The back-light must be thin, but fluorescent tubes which are thin yet large enough to illuminate a liquid crystal panel are rather delicate. The back light often therefore comprises a thin transparent plastic wedge, and a cylindrical fluorescent tube adjacent to the thick end of the wedge.

Light from the fluorescent tube enters the wedge through its thick end, then propagates along the axis of taper by total internal reflection off the wedge/air interfaces, as shown in figure 1. Each time a ray reflects off one side of the wedge, the ray's angle relative to the normal of the opposite side decreases. Eventually the critical angle is reached and the ray emerges into air. Unless they have been scattered, rays emerge from the wedge in a direction close to the plane of the wedge/air interface. A prismatic film is therefore often placed over the surface of the wedge in order to deflect the rays so that their average direction is perpendicular to the wedge/air interface.

The material out of which the wedge is made is often designed so that it slight scatters light. The effect is that the direction of light which emerges from the wedge is diffuse so that the image on the liquid crystal panel can be seen over a wide field of view.

If an eye follows the image of a ball as it moves across a screen then in order to avoid blur, the image of the ball should shift by one pixel every time the centre of attention of the eye shifts by one pixel. However, the moving image on a video display is comprised of still pictures called frames which are renewed every sixtieth of a second. Suppose that the image of a moving ball is being displayed, and that the image shifts ten pixels between each frame. At the start of each frame, the image of the ball coincides instantaneously with the centre of attention of the eye, but with each tenth of a frame period the centre of attention of the eye shifts by one pixel whereas the image of the ball remains where it is. The image of the ball therefore becomes blurred by up to ten pixel widths.

Cathode ray tubes avoid blur because pixels are pulsed, so that the eye only sees the image of the ball at the start of each frame when the image coincides with the centre of attention of the eye. The eye sees nothing further until the image again coincides with the centre of attention of the eye, and the dark period in between is imperceptible because the

eye cannot detect flicker at periods of a sixtieth of a second. One way of eliminating blur in a liquid crystal display is to configure the liquid crystal so that it behaves like a cathode ray tube by relaxing into a dark state soon after being addressed. However, blocking light for large parts of the duty cycle wastes power. Another way of eliminating blur used in video projectors is to scan illumination across the liquid crystal display, but this requires bulk optic systems which are acceptable in video projectors but unacceptable within the flat form factor which makes liquid crystal displays so attractive.

This invention describes a flat panel scanning illuminator which comprises a transparent wedge, and means for scanning the direction of light injected into the thick end of the wedge. A specific embodiment of the invention will be given by way of example in which:

Figure 1 shows how the angle at which light is injected into a wedge alters the position at which the light emerges.

Figure 2 shows in side and front views how three lines of light emitting diodes can be placed at different positions within the focal plane of a mirror so that each illuminates a different segment of the liquid crystal display.

Figure 3 is the same as figure 2 but shows how the screen is illuminated a third of a frame later.

Figure 4 is the same as figure 2 but shows how the screen is illuminated two thirds of a frame later.

Figure 5 shows in side and front views how a pair of wedges with shared thick ends can be used to direct light from three lines of light emitting diodes to different areas behind a liquid crystal panel.

An wedge 1 which is entirely transparent and free of scattering inclusions has its thick end illuminated by LED arrays 2, 3 and 4 which are in the focal plane of a cylindrical mirror 5. Once the top third of a frame has been written to a liquid crystal display, LED array 2 is illuminated. Light from this array is collimated into a set of angles which, after injection into the thick end of the wedge 1, go on to emerge from the top third of the wedge 1. Here the rays should be bent to the normal by a sheet of prismatic film 6 and diffused, either before or after passing through the liquid crystal display 7.

Once the centre third of the frame has been written to the liquid crystal display, LED array 2 is switched off and LED array 3 is switched on, as shown in figure 3. Light from LED array 3 is collimated into a set of angles which, after injection into the thick end of the wedge, go on to emerge from the centre of the wedge.

Lastly, once the bottom third of the frame has been written to the liquid crystal display, LED array 3 is switched off and LED array 4 is switched on so as to illuminate the bottom third of the liquid crystal display. Simultaneous to this, the top third of the next frame will begin to be written to the top third of the liquid crystal panel, and so on.

Colour pictures require red, green and blue LED's, and it is conventional to interleave these in order to mix light of different colours before it reaches the liquid crystal display. Furthermore, it is desirable to extend the thick end of the wedge beyond the base of the liquid crystal so that there is a length over which mixing can take place, and so that the illumination is uniformly white at the base of the liquid crystal panel and beyond. This extended section will need to be longer with the scanning illumination scheme because LED's illuminating a particular region of the liquid crystal panel at a particular wavelength will be more widely spaced than is conventional. But the extended section can be folded behind the liquid crystal panel with prisms, so the extra length of the extended section does not create an unacceptable change in form factor.

The cylindrical mirror is a slightly bulky element and it may be advantageous to exchange it for a second short wedge 8 which acts as an input element for the illumination wedge 1 as shown in figure 5. The input wedge 8 acts in reverse, so light injected near the tip of wedge 8 from LED 2 forms rays with a shallow angle at the interface between wedge 8 and wedge 1, and therefore emerges near the tip of wedge 8. Whereas light injected near the base of wedge 8 forms rays with a steep angle at the interface between wedge 8 and wedge 1, so the light emerges near the base of wedge 8.

If a liquid crystal display is to produce a picture which comprises large areas of black, power could be saved by not illuminating the black areas. For example for any one frame, if all the pixels in the top third of the liquid crystal panel have grey levels less than half peak brightness, then power can be saved during that frame by doubling the transparency of each pixel in the top third of the liquid crystal panel and halving the illumination of the light emitting diodes 2.

It may be desirable also to illuminate a particular set of columns, or a particular intersection of rows and columns. This can be done by replacing the cylindrical mirror 5 with a spherical mirror, and placing in the focal plane of the spherical mirror a two dimensional array of light emitting diodes. The thick end of the wedge will need to be extended sufficient to allow rays reflected off the spherical mirror to fan out to the full width of the liquid crystal panel, whereupon each light emitting diode in the array will illuminate a particular intersection of rows and columns and can have its emission intensity modulated in order to optimise power conservation.

Alternative arrangements are that the cylindrical mirror 5 can be replaced with a lens, hologram or other imaging element, and the light emitting diodes 2,3,4 can be replaced with fluorescent lamps, electroluminescent strips, or other rapidly switchable light emitting elements.

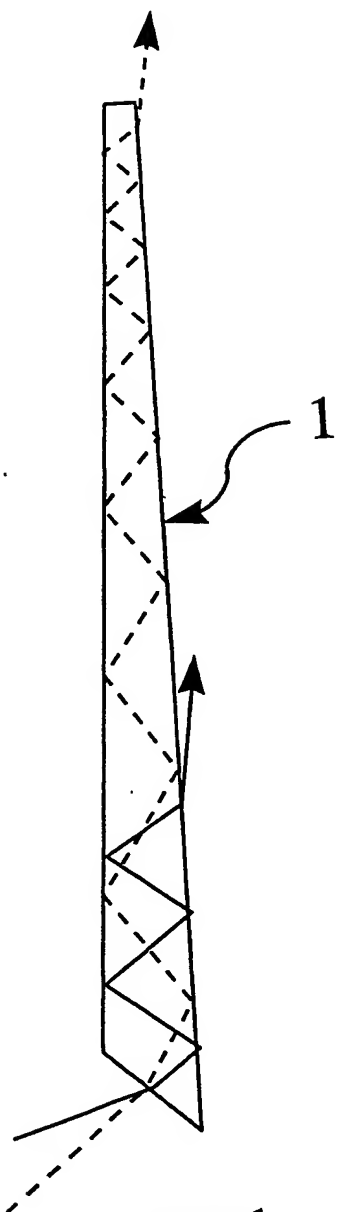

Figure 1

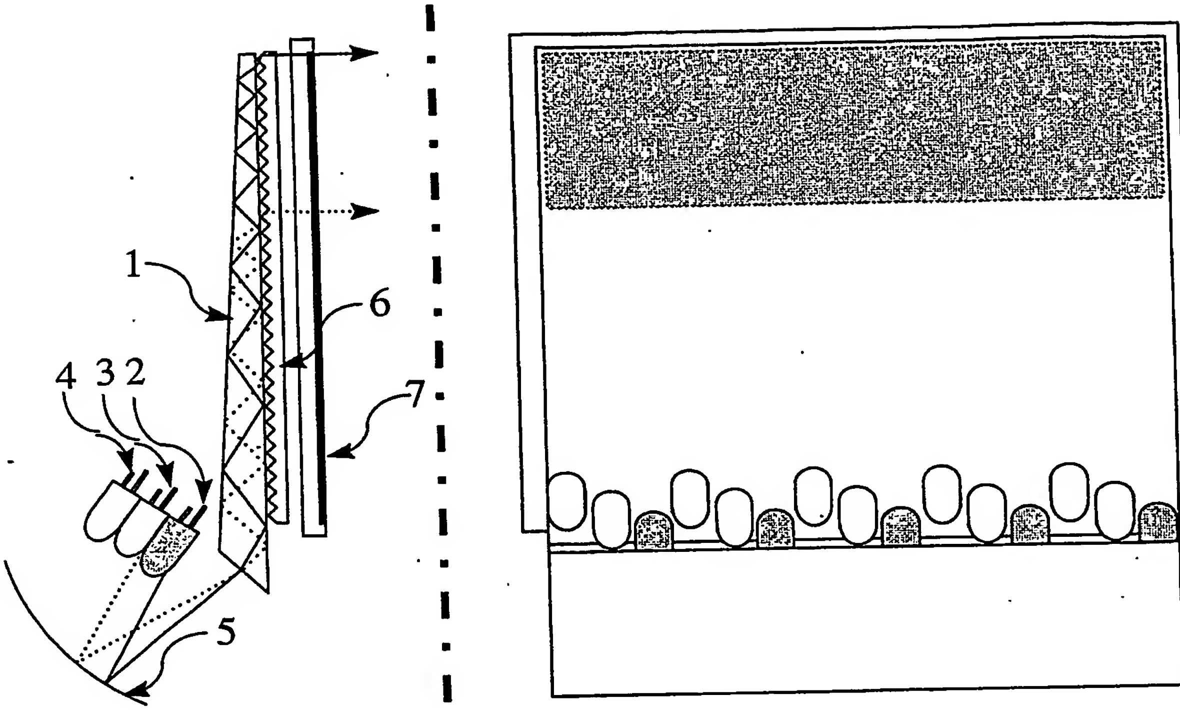

Figure 2

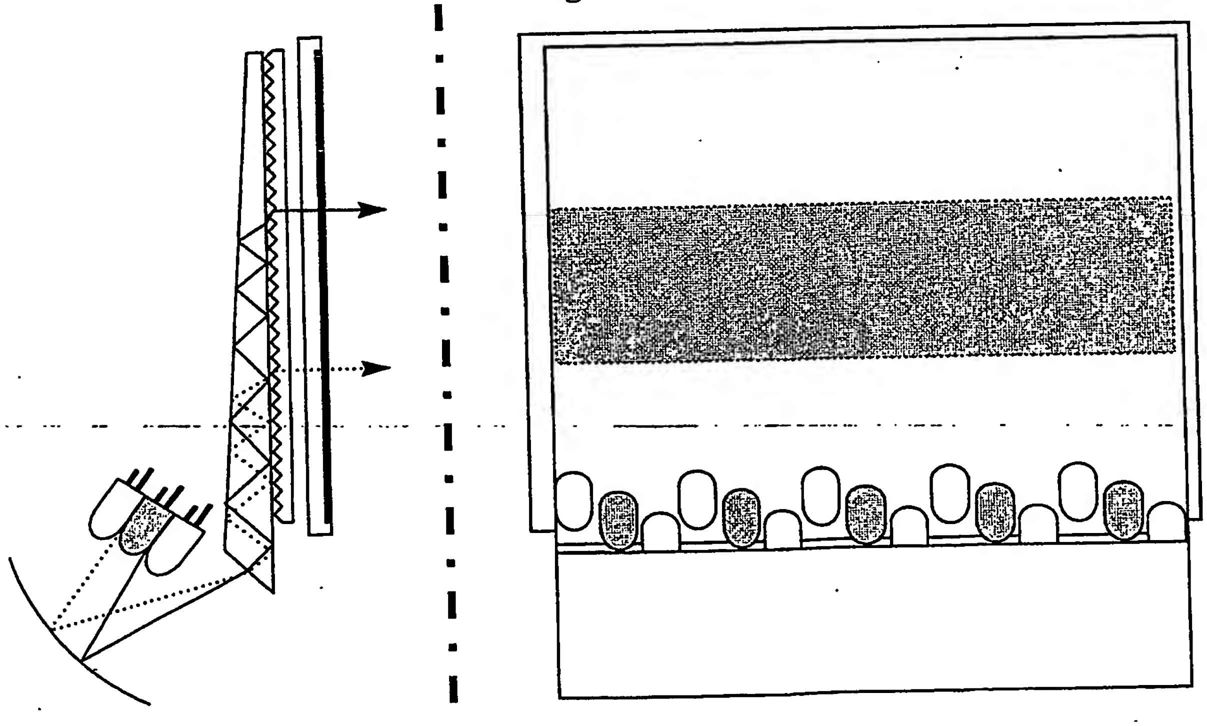

Figure 3

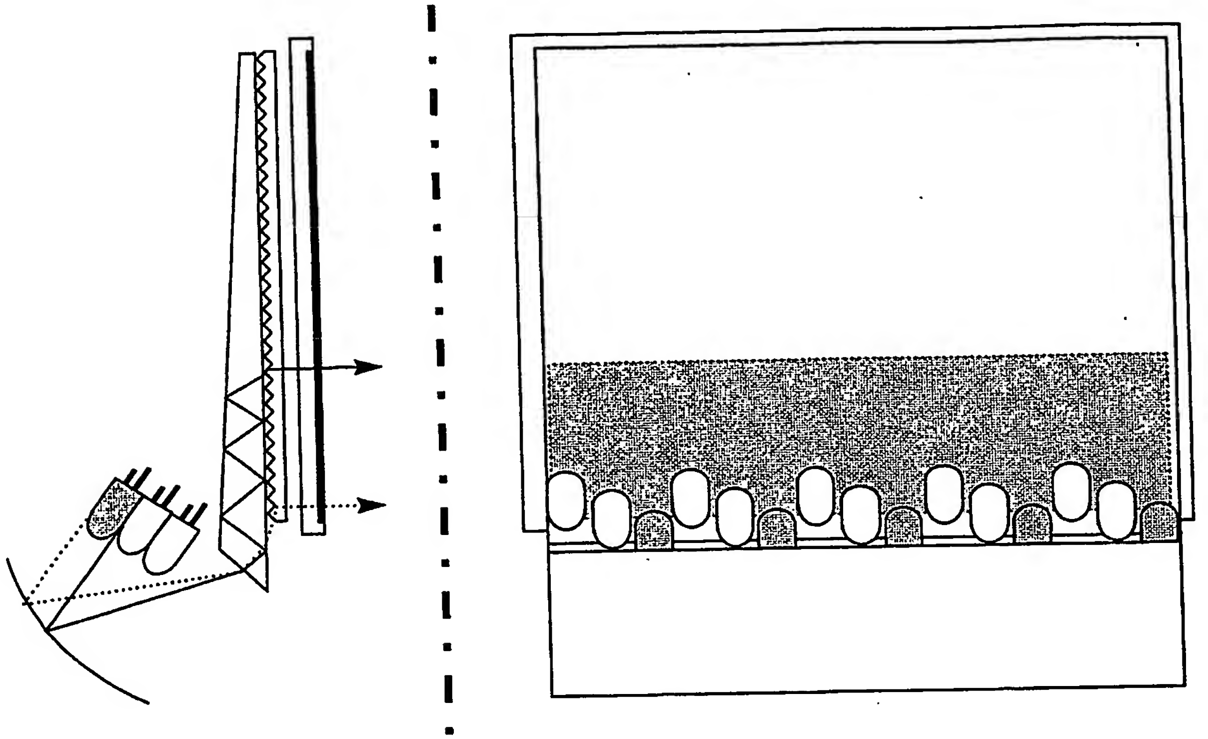

Figure 4

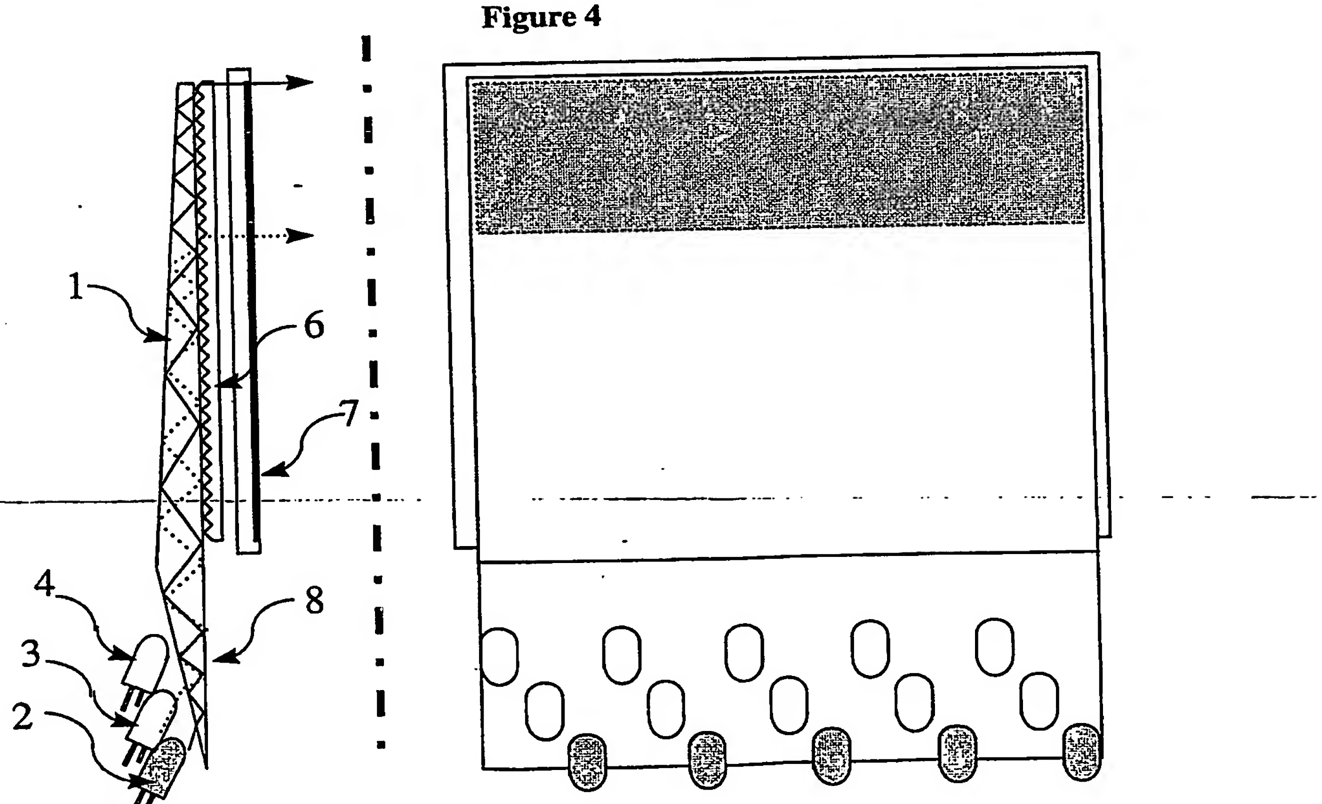

Figure 5

This Page is Inserted by IFW Indexing and Scanning Operations and is not part of the Official Record

BEST AVAILABLE IMAGES

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images include but are not limited to the items checked:

- ☐ BLACK BORDERS
- ☐ IMAGE CUT OFF AT TOP, BOTTOM OR SIDES
- ☒ FADED TEXT OR DRAWING
- ☒ BLURRED OR ILLEGIBLE TEXT OR DRAWING
- ☐ SKEWED/SLANTED IMAGES
- ☐ COLOR OR BLACK AND WHITE PHOTOGRAPHS
- ☐ GRAY SCALE DOCUMENTS
- ☒ LINES OR MARKS ON ORIGINAL DOCUMENT
- ☐ REFERENCE(S) OR EXHIBIT(S) SUBMITTED ARE POOR QUALITY
- ☐ OTHER: ______________________

IMAGES ARE BEST AVAILABLE COPY.
As rescanning these documents will not correct the image problems checked, please do not report these problems to the IFW Image Problem Mailbox.